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THE MONTHLY

MICROSCOPICAL JOURNAL:

TRANSACTIONS

OF

The Royal Microscopical Society,

AND

RECORD OF HISTOLOGICAL RESEARCH

AT HOME AND ABROAD.

All Microscopists who care to know what is going on at home or abroad should take in this Journal.

THE

MONTHLY MICROSCOPICAL JOURNAL:

TRANSACTIONS OF

The Royal Microscopical Society,

AND RECORD OF HISTOLOGICAL RESEARCH.

Edited by HENRY LAWSON, M.D., F.R.M.S.,

ASSISTANT PHYSICIAN TO, AND LECTURER ON HISTOLOGY IN, ST. MARY'S HOSPITAL.

This Journal, which commenced in January, 1869, is devoted exclusively to the interests of Microscopical Science in the widest and most accurate sense of the term. It contains not only the proceedings of the Royal Microscopical Society, but also embraces communications from the leading Histologists of Great Britain, the Continent, and America, with a comprehensive *résumé* of the latest Foreign Inquiries, Critical Reviews and Short Notices of the more important works, Bibliographical Lists, and descriptions of all New and improved forms of Microscopes and Microscopic Apparatus; Correspondence on all matters of Histological Controversy; and finally, a Department of 'Notes and Queries,' in which the student can put such questions as may elicit the special information he desires to obtain.

The Editor has also made arrangements for the publication of the most important Papers read before Local Associations. Contributions requiring illustration are accompanied by most carefully drawn Plain or Coloured Plates, and the text is printed in clear and legible type, thus affording the Microscopist a readable Monthly Record of all that takes place in the branches of science specially interesting to him. By thus providing a journal at once thoroughly scientific, advanced, and comprehensive, and issued at such short intervals as to meet the requirements of active investigators, the Publisher hopes to receive the support of all workers with the Microscope, and the assistance and co-operation of all who desire to possess a periodical which creditably represents the labours of British and Foreign Histologists.

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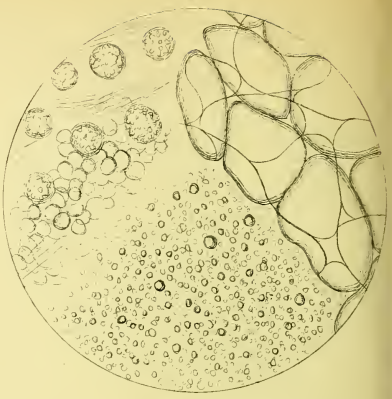
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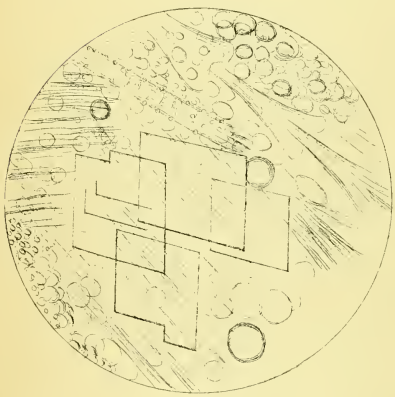
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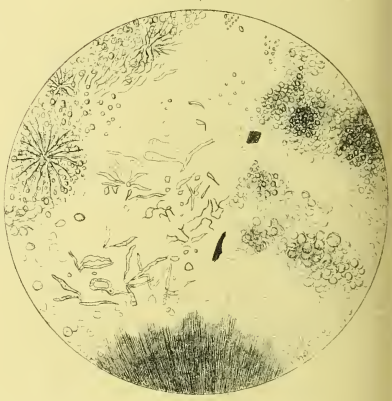
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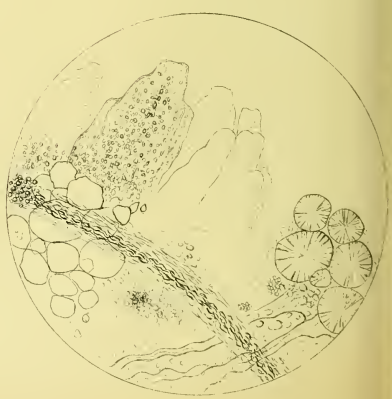
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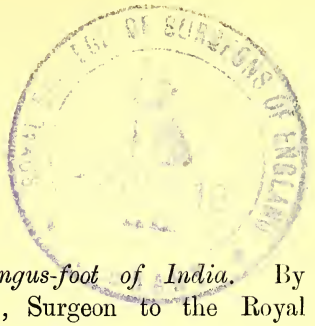


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"The Madura". Fungus foot of India.



I.—*Mycetoma: the Madura or Fungus-foot of India.* By Jabez Hogg, Hon. Sec. R.M.S., Surgeon to the Royal Westminster Ophthalmic Hospital, &c., &c.

(*Read before the* Royal Microscopical Society, *June* 7, 1871.)

Plate XCII.

A few years ago Dr. Vandyke Carter, of the Bombay army, made us acquainted with a certain specific form of microscopic fungus, which he alleges produces, among the native inhabitants of Madura, and certain other districts in India, a peculiar disease, and since recognized as the *Fungus-foot of India* (Mycetoma). A number of specimens of the foot have been examined in this country, and it is thought by some histologists and pathologists that most of them exhibit the ravages of a fungus. It appears, however, that now and then specimens have failed to satisfy those into whose hands they have fallen of the fungoid character of the disease; Dr. Carter speaks of such specimens as a variety, and in place of a living fungus he says "numerous rounded bodies of a structureless or finely granular appearance are seen, in which the fungus particles were free from crystalline fringe, but still showing a cellular structure, the true nature of which is *degenerate fungi*."* A

DESCRIPTION OF PLATE XCII.

No. 1.—Altered fibrous tissue, mulberry-shaped fat-cells, &c., × 150.
„ 2.—Fat-vesicle and molecular matter, chiefly fat; a few mother-cells filled with fat-granules, and granular contents of others distributed over field. × 150.
„ 3.—Crystalline matter (stearine? &c.), fat-globules; vegetable hairs, &c. × 150.
„ 4.—Algoid filaments in matrix or stroma with fatty molecules and pigment granules, × 150. This specimen was taken from the second or more frequently recurring form of diseased foot.
„ 5.—Portion of a foot bone, the compact tissue and lamellæ of which have been removed, and the cancellous structure occupied by blacked masses of inorganic matter, × 50.
„ 6.—Papillæ hypertrophied, and filled with granular matter; remains of a capillary seen running over the field; connective tissue and fat-corpuscles filled with crystalline particles. × 150.

* 'Trans. Bombay Medical Soc.,' 1860, '61, and '62; 'Medico-Chir. Review, vol. i., 1863.

specimen of this "variety" appears to have perplexed Dr. Ballingall, as well as the late eminent microscopist, Professor Quekett, both of whom were in consequence unable to pronounce the disease to be fungoid; due to the growth and ravages of a fungus. At the end of the year 1869, a foot of the doubtful kind was placed for examination in my hands, and those of a well-known excellent pathologist and histologist: I was requested to report on the specimen. You may imagine, therefore, I was most anxious that everything should be conducted with the care and caution which so responsible a position would naturally inspire. I will tell you at once I was not a little surprised and disappointed to be obliged to come to the conclusion that no trace of a fungus could be found in any part of the foot; I say disappointed, because from what I had read about the fungus-foot disease of India, I expected no difficulty whatever in the matter, and I will add more by way of caution, that the first few sections which were made and washed in distilled water, for the purpose of freeing them from some apparently crystalline and fatty matters, showed both the spores and mycelium of a fungus. Here then I thought there could be no mistake, and put the specimens away to further examine at a more convenient opportunity. The next day I resumed my work, and made other sections from the foot, which I at once transferred to a weak solution of spirit and glycerine. On examining them I was not a little puzzled to find abundance of fatty matters, but not a particle of anything like a fungus. Subsequent examinations convinced me an error had occurred somewhere in my first observations, and I then examined the distilled water. A single dip from the bottle gave me a plentiful crop of fungus, exactly resembling that found in my first specimens. On taking up a well-corked bottle of arsenical solution standing near the distilled water, I saw it contained numerous tufts of a fungus, which, as you know, abound everywhere, and spread with amazing rapidity upon almost everything, ripening and depositing their spores, with powers of self-increase so rapid as to be almost incredible. The naked-eye appearances of this fungus-foot may thus be briefly stated. The foot was greatly enlarged and swollen; all fair outline being lost. There were numerous excrescences or raised bodies over the upper surface; none on the lower; which at first sight might be supposed to communicate with the internal parts; but on attempting to pass a small silver probe through the centre of any one of them, it could not be made to penetrate more than a very short distance, and I doubt very much whether there could have been any actual sinus leading to the bone at any time. There might, however, have been an ulcerating sore during life, which the hardening nature of the methylated spirit, in which the specimen was preserved, had entirely obliterated. On making a vertical section of

the foot, so much confusion of parts existed, that the muscular, fibrous, and other tissues seemed to be blended in a gelatinous mass; on removing portions of the bony mass, the cancellated interspaces, which were much larger than usual, were occupied by numerous whitish granular bodies, somewhat resembling millet seeds. These bodies, which are described by Dr. Carter as pink in the fresh foot, were apparently mixed up with a crystalline material. But fatty matter so predominated that it was almost impossible to free any section from it, without resorting to boiling in æther, or liquor potassæ. When boiling in the latter was continued for a few minutes, nearly the whole was held in solution, the residue being a very small quantity of fibrous tissue. Even fragments of bone almost disappeared when treated in the same way; whereas, if the spores and mycelium of a fungus are subjected to the same process, the fragments that remain enable us to recognize them without difficulty. Fungi resist the action of boiling fluids as they do prolonged and intense cold, so that we need be under no apprehension of losing all trace of them, if they ever had an existence, while subjecting animal matters to the crucial test of boiling in destructive reagents. A prolonged and exceedingly careful microscopical examination yielded only negative results, so far as fungi were concerned. The cells and fibres which Dr. Carter says "are imbedded in black masses of matter," could nowhere be traced; neither could I see "the fish-roe-like substances made up of defaced fungus structure." The little rounded bodies in this specimen were not uniform in structure, and were mostly imbedded in a gelatinous fatty matter in the interspaces of the bones. The pigment of the skin, generally so abundant in the black races, was entirely removed; while the papillæ were so much hypertrophied, swollen up, that all trace of ordinary structure seemed lost, not even a perfect epithelial cell remaining. The extraordinary way in which the pigment had disappeared induced me to think that even "black fungus masses" might owe much of their colour to disintegrated pigment granules, and even take up new forms in the interspaces of the metamorphosed muscular and fibrous tissues. Portions of the subfilamentous material presented, at first sight, an appearance somewhat resembling ciliated epithelium; these masses easily separated and floated about, and there was no nucleus seen, and only a slight fibrillation. Fat abounded and was often arranged and massed in cells, in which were groups of smaller corpuscles, in some instances presenting a false appearance of nucleated cells. The subcutaneous infiltration of fatty matter, and the disintegration of nervous matter, muscular and other tissues occasioned thereby, gave to all the specimens examined a confused resemblance; and although some few bodies of "a spindle shape" were seen, it would require a considerable stretch of imagination to believe that

they were either "ciliated epithelium," "degenerate fungi," or the altered forms of "a true oidium," the material contents of "the branching tubular canals" of which had become altered through some kind of natural quiescence or encystment. If it be possible for such encystment to take place, it must, in my opinion, be a complete disguise of all known fungus characteristics, and under such a disguise it was not at all surprising the late Professor Quekett should fail to come to "any definite opinion of its character." I would not have you suppose that a doubt exists in my mind about the finding of fungi by Dr. Carter, in connection with the remarkable form of disease with which he has made us acquainted. I have placed a section under a microscope, taken from a recent specimen sent over to this country, and now in the possession of Dr. Tilbury Fox. It belongs to the more frequently occurring form of disease, and in which are seen many black, or deep-brown coloured masses, either closely aggregated, or having a radiating aspect, branching out in every direction;* and what to me seems very curious, several spore-like bodies closely resembling "Puccinia" have been found; which being a vegetable feeder, should not, according to the Rev. Mr. Berkeley, occur among animal matter. On the same authority we are assured "there is not the slightest ground for supposing that the disease depends on inoculation with the spores of the true parasitic fungi belonging to the rusts and mildews."† Nevertheless I believe such spores, as well as the conidial form of oidium, have been found in a few of the specimens; these may, however, have been accidentally introduced from without. Dr. Carter does not tell us whether the less frequently observed variety of diseased foot, that is, the foot in which "degenerate fungi" and numerous rounded bodies are seen to be the chief elements of destruction, is a more advanced, has existed longer, or is a worse stage of disease. It ought to be so if the fungi are in a more advanced condition; but it certainly is not, that is, if ordinary appearances can be accepted as any guide to a conclusion on such a point. I can hardly believe, however, that what he describes as "degenerate fungi" are fungi at all. I am ready to admit, however, so much of Mr. Berkeley's argument, that at times "they so nearly simulate fungus growths, that it is difficult to get rid of the notion that they are really vegetable growths." But if they were, I see no proof anywhere adduced to show that the diseased condition, described as due to a fungoid growth, is really so; and this is the important point, one which

* Since my paper was read, my friend Mr. Bell has made a chemical analysis of these "black masses," and finds them to consist "of fatty matter, phosphates of iron and lime, a little carbonate of lime, and a minute quantity of an organic substance, albumen or fibrine."

† Rev. M. J. Berkeley "On the Fungus-foot of India," 'Intellectual Observer,' vol. ii., 1863, p. 248.

should, if possible, be cleared up. Are not the algoid filaments another instance of a vegetable growth rapidly developed after death in a putrescible substance? It is a matter of some moment in a scientific point of view, that this question should be carefully investigated and answered, for I find the eminent Mycologist already referred to accepting Dr. Carter's hypothesis as a demonstrated fact, describing the fungus as a *new species*, and assigning to it a name; remarking, at the same time, that "although the fungus resembles closely the genus Mucor, there is no columella in the sporangium, a character which accords with Chionyphe rather than Mucor;" nevertheless he places it with the latter, while he admits that Chionyphe is one of those species *only found under snow*. He concludes with what I should regard as a bit of special pleading for a pet hypothesis, because you must remember while we are discussing the action of a fungus in a living animal, Berkeley refers solely to its action on dead matter; and whatever that action may be, there can be no similarity in the two processes. "It is," he observes, "highly probable that many of our common moulds commence with a similar condition. The first indication of a change in tainted meat, is seen to commence with little gelatinous spots of vegetation of various colours, the early stage of some curious species of Aspergillus, or Penicillium."* Hospital gangrene may, he thinks, also depend upon a similar cause. I think, neither Mr. Berkeley nor anyone else can bring forward a particle of proof in support of such a probability, and which is after all no nearer the truth than the many guesses that have been made at a germ-theory of disease generally. To establish Dr. Carter's fungoid origin of disease, it is absolutely necessary to show that the spores of a vegetable fungus can get into the dense structures of the animal body during life, there germinate, and destroy the hard bony tissues, and ultimately kill the patient. At a glance, the character of the tissues might seem to make this impossible; and Mr. Berkeley evidently has his misgivings on the point, for he writes, "the little granular bodies are so closely involved in stearine, that their germination is scarcely probable." If we next take the symptoms and appearances which usher in the disease as described by Dr. Carter, we shall see how far it may become possible for fungi to pass in through the sinus openings. "The foot swells up, is of a dark colour, numerous sinuses appear, with pink stains or streaks, which penetrate the subjacent tissues, and end in spherical groups of bright orange-coloured particles. The sinuses are more or less lengthy and tortuous, and will not

* In the 'Intellectual Observer' we are favoured with a somewhat remarkable series of illustrations, of some very curious matters. A whole page is given, resembling nothing in the shape of fungi, but rather what I should regard as extraneous vegetable particles in a specimen.

usually yield to *pressure of the probe*," &c. Nevertheless we are expected to see that the soft, yielding spores of a fungus will find their way through these tortuous sinuses, passing along in an opposite direction to a strong outward flow of a sanious discharge, which usually accompanies such a condition of disease. Again, the existence of a sinus presupposes a grave state of disease. Dr. Carter does not for a moment believe that the sporules, although minute enough, could possibly enter through the circulation. A more generally expressed opinion, and an equally probable mode of conveying the contagium to the internal parts of the body, the endemic character of the disease, would, in this way, be more easily accounted for in districts where the growing crops of rice were at one time seen to be devastated by "smut," and thought to be the cause of the cholera visitation. But it could not be believed to enter through the blood, because in such a case it would be impossible to understand why the spores of a fungus should select a hand or a foot, and find in them a more congenial soil than in other parts of the human frame; why one foot should be destroyed and the other escape; or why the poison should stop at the part where the bones of the leg join the foot, and so forth.

The constant occurrence in the internal organs of algoid growths has long been noticed—Sarcina, for instance, in the stomach and bladder; but after the disease has existed for years, it has not been observed to destroy life; indeed it often produces so little disturbance, that it is only detected after death. The other so-called fungoid diseases, such as those which some believe to be the cause of gangrene, cholera, &c., I need not dwell upon, because they rest their claims to consideration upon the most inconclusive of experiments and observations.

The incubation of the disease demands a passing notice; as, according to Dr. Carter, it more frequently affects the agricultural classes, men in the vigour of life; is not associated with any constitutional causes, and is not known to be transmitted. But as agricultural labourers go about barefooted, and seldom wash their feet thoroughly, it therefore happens that the spores of a fungus penetrate the hardened skin, and produce "worse ravages than the dreaded guinea-worm." I must confess I do not understand this peculiar line of argument; for although I can easily see how the guinea-worm makes its way through the skin, particularly if softened by standing in water, I cannot see how the spores of a fungus should be capable of exerting the same force as an animal parasite provided with a mouth and jaws, and a strong desire to provide a comfortable lodging in the leg or foot of the first animal that comes in its way.

It must be admitted, if the disease originates in a fungoid growth there should be no instance of a foot which does not

bear evidences of the characteristic poison. Such a specimen as I have been discussing, without a particle of fungus, is enough to invalidate and destroy the superstructure upon which Dr. Carter builds his hypothesis of the "*fungoid foot*"; and my objection is in no wise met by saying that this form of disease is exceptional, and the appearances observed are those of "degenerate fungi," &c. To this I reply, it is apparently a form often met with. Mr. Henry J. Carter, F.R.S., in his early investigations of the disease, found only a large quantity of albuminoid and fatty matters, and attributed the changes observed to fatty degeneration. He, however, subsequently examined other specimens in which he discovered fungi, and changed his opinion, but he adds, "I could scarcely overcome the difficulty in believing it possible for a fungus to destroy the bones as well as the other tissues of the foot." Another excellent observer, Dr. Bristowe, a gentleman who has examined several specimens of the disease, writes:—"Although the soft parts are infiltrated with a lump of *truffle-like bodies*, I am not prepared to say that the fungus causes the disease; it rather seems to me probable that the primary disease was caries of the bones, and that the fungus became developed subsequently and accidentally. The latter view is supported by the nature of the foot which you examined." I feel bound to believe with Dr. Bristowe that the disease is due to caries of the bones; occurring, perhaps, in a strumous, scrofulous, or syphilitic constitution. In caries, we find a similar train of pathological appearances; the bony structures are filled with a sanious, or glary fluid, soft granulations springing up, and a deposit of tuberculous material, with an increase of fat, causes complete destruction of the bones. The slow disintegration of the various structures in the Madura foot disease is exaggerated by the ordinary effects of a tropical climate, often an important factor in disease, and one well exemplified in those remarkable forms elephantiasis and leprosy, both of which seem to originate in a metamorphosis of cell contents, a condition not unfrequently noticed in pathological anatomy. The deposition of fat in cells and structures of all kinds is perhaps of all changes the most curious and universal. A beautiful series of transformations is often traced in fat-cells, which, according to the deficiency or excess of nutritive fluid, lose, in the former case their contents, and eventually contain only serum, in the latter become distended with fat-globules; further, in the cells of glands secreting fat, which, at first poor in fat, are ultimately quite distended with it. Also in the ova of all animals which deposit fat and proteine within themselves.

In the case before us of the Madura foot, the fatty degeneration, or disintegration, commences in the bones of the foot, and physiological phenomena are gradually merged into pathological. A similar instance is presented in the amyloid "*Lardaceous*" disease,

which invades various parts of the body. Large quantities of a fatty material accumulate from a supposed deficiency in the quantity of alkali in the blood. Complexity of structure in the known characters of organic compounds seems to be never better exemplified than it is when large quantities of fatty matters enter into nitrogenous compounds. As an example, the decompositions effected by butyric acid seem to be endless, and more especially so when connective and fibrous tissues enter into these decompositions, and give new shapes and characters to the organic molecules. These again are immensely changed, and other transformations effected by the putrefactive process. Animal matter in a state of putrefaction acts as a ferment, rapidly changing albuminoid and fatty particles into a fungus, and is capable of causing their metamorphosis into sugar, alcohol, and carbonic acid. It may be possible that an allied process is going on in connection with the Madura foot disease, a putrefactive ferment, a process of chemical disintegration while the limb is still in connection with a living body, although itself dead. I have before ventured to affirm that parasitic fungi are characterized throughout nature by feeding on effete or decayed matters, and I see no reason for changing my opinion. This view of them seems to have been floating in the mind of the Rev. Mr. Berkeley, for he concluded the paper I have already referred to, by observing:—"In some cases it would seem as if the foot was already in a diseased state when the fungus was introduced: at least the history of one case which apparently commenced with a boil in the instep, and opened by a thorn, indicates such a lesion as might well encourage the growth of a fatal parasite."

I readily admit that Dr. Carter's great experience of Mycetoma, and the many opportunities he has had of making examinations soon after amputation of the foot, entitles his opinion to great weight. I should indeed have been much inclined to accept his views from this circumstance, provided he could have furnished indisputable or reasonable evidence that "Mycetoma stands for a form of swelling which is caused by the growth of a fungus." I have endeavoured to place the matter before you in an impartial spirit, hoping thereby to assist in the elucidation of an important question, at the same time trusting I may have made the subject sufficiently interesting to induce the Fellows of this Society to investigate it for themselves: if they do I can promise this much, that they will find it of far more importance, if not more interesting, than the markings on Diatoms and Podura scales.

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